NATIONAL BUREAU OF STANDARDS REPORT

INSTITUTE FOR BASIC STANDARDS

GPO PRICE $ ____________

CFSTI PRICE(S) $ ____________

Hard copy (HC) 1.00

Microfiche (MF) .50

ff 653 July 65

Harold J. [illegible] and Walter J. [illegible]

N66 37275
(ACCESSION NUMBER)

(THRU)

4
(PAGES)

1
(CODE)

CR-78145
(NASA CR OR TMX OR AD NUMBER)

06
(CATEGORY)

FACILITY FORM 602

Quarterly Report [illegible]

for period April 1, [illegible] to June 30, [illegible]

U.S. DEPARTMENT OF COMMERCE

NATIONAL BUREAU OF STANDARDS

NATIONAL BUREAU OF STANDARDS REPORT

NBS PROJECT		NBS REPORT
2110432	August 15, 1966	9394

ELECTROCHEMICAL DATA

Part III

by

Harold J. DeWane and Walter J. Hamer

Quarterly Report for period

April 1, 1966 to June 30, 1966

NASA Contract Number: R-09-022-029

NBS

U. S. DEPARTMENT OF COMMERCE

NATIONAL BUREAU OF STANDARDS

Electrochemical Data

I. Introduction

This report gives the equivalent conductance of hydrochloric acid at 25°C at rounded concentrations between 1.0×10^{-4} and 11.6 N in absolute mhos. in table 1. The theoretical constants used were those given in Part I of this series of Reports. They were incorporated into the following empirical equation to evaluate the data over the whole range:

$$\Lambda = \Lambda_\circ - Sc^{1/2} + Ec \,\ell og\, c + Ac + Bc^{3/2} + Cc^2 + Dc^{5/2}$$

This was rearranged for fitting to the following form,

$$\Lambda - (\Lambda_\circ - Sc^{1/2} + Ec \,\ell og\, c) = Ac + Bc^{3/2} + Cc^2 + Dc^{5/2}$$

for the lower range of concentrations and altered to,

$$\Lambda - (\Lambda_\circ - Sc^{1/2}) = Ac + Bc^{3/2} + Cc^2 + Dc^{5/2}$$

for the higher concentrations. It was necessary to divide the data into four concentration ranges to obtain reasonable least square fits. After the empirical coefficients were obtained from the fit, the theoretical terms were returned to the righthand side of the equation, and the equivalent conductance computed at the various round concentrations. As the concentration decreases the equation reduces to the Fuoss-Onsager-Accascina equation.[1]

---

[1] R. M. Fuoss and F. Accascina, Electrolytic Conductance, Interscience Publishers, Inc., pp. 191-205, 1959.

TABLE 1 - Equivalent electrolytic conductance of hydrochloric acid at 25°C

c	Λ	c	Λ	c	Λ	c	Λ
0.0001	424.5	0.08	393.8	2.4	263.2	6.8	121.1
.0002	423.8	.09	392.4	2.5	258.9	7.0	116.9
.0003	423.3	.1	391.1	2.6	254.5	7.2	112.8
.0004	422.9	.2	381.1	2.7	250.2	7.4	108.9
.0005	422.5	.3	373.5	2.8	246.0	7.6	105.2
.0006	422.2	.4	366.9	2.9	241.8	7.8	101.6
.0007	421.9	.5	360.7	3.0	237.6	8.0	98.2
.0008	421.7	.6	354.8	3.2	229.8	8.2	94.9
.0009	421.4	.7	349.0	3.4	222.1	8.4	91.8
.001	421.2	.8	343.3	3.6	214.5	8.6	88.8
.002	419.3	.9	337.7	3.8	207.2	8.8	85.9
.003	417.9	1.0	332.2	4.0	200.0	9.0	83.1
.004	416.7	1.1	326.7	4.2	193.1	9.2	80.4
.005	415.7	1.2	321.4	4.4	186.4	9.4	77.9
.006	414.8	1.3	316.1	4.6	179.8	9.6	75.4
.007	414.0	1.4	310.9	4.8	173.5	9.8	73.0
.008	413.2	1.5	305.8	5.0	167.4	10.0	70.7
.009	412.5	1.6	300.8	5.2	161.4	10.2	68.5
.01	411.9	1.7	295.8	5.4	155.7	10.4	66.3
.02	407.1	1.8	290.9	5.6	150.2	10.6	64.2
.03	403.7	1.9	286.1	5.8	144.9	10.8	62.2
.04	401.0	2.0	281.4	6.0	139.7	11.0	60.2
.05	398.9	2.1	276.8	6.2	134.8	11.2	58.5
.06	397.0	2.2	272.2	6.4	130.0	11.4	56.4
.07	395.3	2.3	267.7	6.6	125.5	11.6	54.1

Concentration Range: 0.0001 - 0.01 N

$$\Lambda = \Lambda_\circ - Sc^{1/2} + Ec\, \ell og\, c + Ac - Bc^{3/2}$$

$$\Lambda = 426.06 - 158.63\, c^{1/2} + 206.31\, c\, \ell og\, c + 816.29\, c - 2357.1\, c^{3/2}$$

Standard Deviation 0.05

Murr B. L., Jr. and Shiner V. J., Jr., JACS, 84, 4672 (1962)

Owen B. B. and Sweeton F. H., JACS, 63, 2811 (1941)

Saxton B. and Langer T. W., JACS, 55, 3638 (1933)*

Shedlovsky T., JACS, 54, 1411 (1932)*

Stokes R. H., J. Phys. Chem., 65, 1242 (1961)

Concentration Range: 0.01 - 0.1 N

$$\Lambda = \Lambda_{\circ} - Sc^{1/2} + Ac + Bc^{3/2} - Cc^{2}$$

$$\Lambda = 426.06 - 158.63\ c^{1/2} + 173.11\ c + 43.515\ c^{3/2} - 345.46\ c^{2}$$

Standard Deviation 0.14

Hlasko M., J. chim. phys., 26, 125 (1929)*

Owen B. B. and Sweeton F. H., JACS, 63, 2811 (1941)

Ruby C. E. and Kwai J., JACS, 48, 1119 (1926)*

Saxton B. and Langer T. W., JACS, 55, 3638 (1933)*

Shedlovsky T., JACS, 54, 1411 (1932)*

Stokes R. H., J. Phys. Chem., 65, 1242 (1921)

Concentration Range: 0.1 - 3.0 N

$$\Lambda = \Lambda_{\circ} - Sc^{1/2} + Ac - Bc^{3/2} + Cc^{2} - Dc^{5/2}$$

$$\Lambda = 426.06 - 158.63\ c^{1/2} + 221.501\ c - 252.771\ c^{3/2} + 115.606\ c^{2} - 19.5824\ c^{5/2}$$

Standard Deviation 0.10

Klochko M. A. and Kurbanov M. Sh., Akad. nauk SSSR, Izvest. sek. Fiz-Khim., analiza, 24, 237 (1954)

---

*Data adjusted to Jones and Bradshaw standard.

Owen B. B. and Sweeton F. H., JACS, 63, 2811 (1941)

Stokes R. H., J. Phys. Chem., 65, 1242 (1961)

Concentration Range: 3.0 - 11.6 N

$$\Lambda = \Lambda_o - Sc^{1/2} + Ac - Bc^{3/2} + Cc^2 - Dc^{5/2}$$

$$\Lambda = 426.06 - 158.63\ c^{1/2} + 143.554\ c - 116.628\ c^{3/2} + 35.2535\ c^2 - 3.56231\ c^{5/2}$$

Standard Deviation 0.15

Hlasko M., J. chim. phys., 26, 125 (1929)*

Howell O. R. J. Chem. Soc., 162 (1929)*

Klochko M. A. and Kurbanov M. Sh., Akad. nauk SSSR, Izvest. sek., Fiz-Khim., analiza, 24, 237 (1954)

Owen B. B. and Sweeton F. H., JACS, 63, 2811 (1941)

II. Λ_o and J of Hydrochloric Acid at 25°C

Data obtained at low concentrations were used to determine values of Λ_o and J, following the procedure given by Fuoss and Accasina on page 200 of "Electrolytic Conductance" and least square fits on the IBM 7090 computer. The results are given in the following table.

TABLE 2 - Values of Λ_o and J of hydrochloric acid at 25°C

Author	Λ_o	Dev.	J	Dev.	Std. Dev.	Measurements
Shedlovsky	426.00	0.07	659.20	47.62	0.16	11
Saxton & Langer	426.35	.08	581.31	15.91	.17	10

*Data adjusted to Jones and Bradshaw standard.

TABLE 2 (continued)

Author	Λ_o	Dev.	J	Dev.	Std. Dev.	Measurements
Owen & Sweeton	426.55	.07	528.69	12.01	.07	5
Murr & Shiner	426.06	.02	636.10	36.62	.04	20
Stokes	426.40	.04	543.98	7.11	.08	9

III. Results at other Temperatures

Data on the equivalent conductance of hydrochloric acid at temperatures from -20 to 65°C are being studied and the results will be given in a subsequent report.